

Special Commentary

Mark Vitner, Senior Economist  
[mark.vitner@wellsfargo.com](mailto:mark.vitner@wellsfargo.com) • (704) 383-5635  
Joe Seydl, Economic Analyst  
[joseph.seydl@wellsfargo.com](mailto:joseph.seydl@wellsfargo.com) • (704) 715-1488

## Cyclical vs. Structural Unemployment: The Debate Rages On

### Introduction: Some Economic Theory, Plus Our Two Cents

The current debate over whether structural unemployment has increased brings to mind one of Harry Truman's most memorable quotes asking that he be given a "one-handed economist" because all of his economists would always hedge themselves by stating, "on the one hand this, but on the other hand that." Unfortunately, while a one-handed economist would certainly be ideal from a policymaking perspective, the discipline of economics is inherently multi-handed. This is especially true with regard to the current state of the U.S. labor market. On the one hand, some economists believe today's high unemployment rate, currently at 9.0 percent, is a cyclical phenomenon resulting from a shortfall in aggregate demand brought about by the bursting of the housing bubble and the financial crisis. On the other hand, some economists believe structural issues—such as mismatches between characteristics of jobs available and skills of workers—have intensified, which is holding back job growth and preventing the unemployment rate from falling at a more rapid pace. We have written previously in support of the latter view, and this paper seeks to expand upon our previous publications.<sup>1</sup>

There are several ways economists attempt to measure structural unemployment. One way involves estimating the natural rate of unemployment, which represents the average level of unemployment in the labor market that stems from sources other than the business cycle. For example, how quickly unemployed workers are matched with job openings naturally brings about some unavoidable unemployment in the labor market. Since the natural rate of unemployment is a long-run theoretical concept that is difficult to observe in real life, many economists prefer an alternative estimate when measuring structural unemployment. The most common alternative measure is the NAIRU, which stands for the non-accelerating inflation rate of unemployment.

The Congressional Budget Office's (CBO) latest estimate of the NAIRU is around 5.0 percent. Most economists agree that the NAIRU has likely risen in the wake of the last recession, but the variance and sustainability of that rise is highly contested. A recent report published by the Federal Reserve Bank of San Francisco (FRBSF) estimates the NAIRU may have risen as much as 1.7 percentage points in recent years due to the extension of unemployment benefits, an increased mismatch between job seekers and potential employers and the sizable increase in long-term unemployment following the Great Recession.<sup>2</sup> Based on our calculations, we believe the NAIRU has risen by at least that much and is probably around 7.1 percent today.

A key finding in the FRBSF's report, however, is that the rise in the NAIRU is expected to be temporary—a conclusion that we have previously argued against. Save for the temporary extension of unemployment insurance benefits, many of the structural issues in the labor market today reflect a fundamental change in the relationship between capital and labor in the

***Economists remain in heated debate over whether structural unemployment is playing a role in today's labor market.***

***Most economists agree that the NAIRU has likely risen in the wake of the last recession, but the variance and sustainability of that rise is highly contested.***

<sup>1</sup> See our last report on structural unemployment, *The Labor Market Is Far From Out of the Woods* (January 7, 2011), which is available upon request.

<sup>2</sup> Weidner, Justin and Williams, John C. (2011). *What Is the New Normal Unemployment Rate?* Federal Reserve Bank of San Francisco.



***We believe one of the long-lasting outcomes of the Great Recession will be a higher structural unemployment rate.***

***The theory that inflation should be low and inflation expectations should be anchored does not seem to fit well with today's economy.***

production process, which is likely to persist for the foreseeable future.<sup>3</sup> Policy changes, including the rise in the minimum wage and basing future increases on changes in the Consumer Price Index, have also likely boosted the NAIRU.

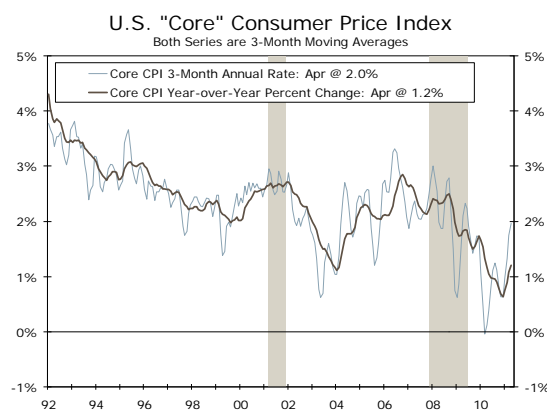
We believe one of the long-lasting outcomes of the Great Recession will be a higher structural unemployment rate. We provide some support for our argument in this brief research note.

### **What is the NAIRU and How Do We Know It Has Risen?**

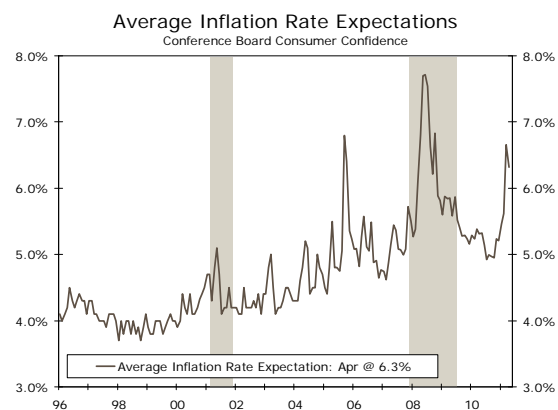
The NAIRU is dubbed the non-accelerating inflation rate of unemployment because it represents a level of unemployment at which there is neither upward nor downward pressure on inflation.<sup>4</sup> In other words, when the actual unemployment rate is below the NAIRU, this implies the demand for labor in the economy is exceeding the supply of labor, which causes firms to bid up wages for additional workers, hire more less-skilled workers and spend more on worker training. These actions, in turn, push labor costs higher, resulting in higher inflation. Conversely, when the actual unemployment rate is above the NAIRU, this implies the existence of an excess supply of labor in the economy, which means employers can be choosier and hire the best workers, reduce wage growth and spend less on worker training. These actions, in turn, exert downward pressure on labor costs, resulting in lower inflation. Given all of this, with the unemployment rate currently at 9.0 percent, which is well above the CBO's and FRBSF's estimate of the NAIRU, we should expect inflation to be low and inflation expectations to be firmly anchored.

The theory that inflation *should* be low and inflation expectations *should* be anchored, however, does not seem to fit well with today's economy. Even excluding volatile food and energy prices, core inflation is currently running at a 2.0 percent annual rate over the past three months, which is up 1.3 percentage points since the start of the year. Moreover, consumers' expectations of inflation 12 months hence call for an average inflation level of around 6.3 percent, which is not far below summer-2008 levels when the price of oil reached \$145 per barrel. In addition, wages are no longer decelerating and benefit costs are rising. Even though inflation remains relatively low, the recent increase in core inflation and rising inflation expectations at a time when the unemployment rate is still very high should be setting off alarm bells. If inflation is picking up with this much slack present throughout the economy, what will happen when the unemployment rate falls and there is even less slack?

**Figure 1**



**Figure 2**



Source: U.S. Department of Labor, The Conference Board and Wells Fargo Securities, LLC

<sup>3</sup> We have written extensively about this in the past. For more information, see *Recovery Gives Way to Expansion, or Does It?* (March 1, 2011) and *Employment Dynamics and State Competitiveness* (April 13, 2011) at: [https://www.wellsfargo.com/com/research/economics/special\\_reports](https://www.wellsfargo.com/com/research/economics/special_reports).

<sup>4</sup> The NAIRU—originally coined NIRU (noninflationary rate of unemployment) by Franco Modigliani and Lucas Papademos in the 1970s—was formally adopted among economists in the 1980s and is a byproduct of the Phillips Curve, which posits that there exists a statistical relationship between unemployment and inflation. The theoretical framework behind the NAIRU, however, is Keynesian, dating back to the 1930s.

## Forget About a Wage-Price Spiral, What About a Benefit-Price Spiral?

From a monetary policy perspective, the biggest threat from an initial pickup in inflation is whether it will ignite a wage-price spiral, whereby higher prices cause workers to demand higher wages, which then feed back into even higher prices and so forth. According to those on the cyclical side of the debate regarding today's high unemployment rate, the recent pickup in inflation and inflation expectations is unlikely to spawn a vicious wage-price spiral given the amount of slack and excess capacity that still exists in the economy. With industrial production still well below its pre-recession peak and an output gap of \$840 billion, they argue, we need to see more hiring and demand in the labor market before higher prices begin to feed into higher wages.

***From a monetary policy perspective, the biggest threat from an initial pickup in inflation is whether it will ignite a wage-price spiral.***

To be sure, wage and salary growth in the United States has been contained over the last few years. Average hourly earnings for private-sector workers has more or less moved sideways since the recession ended in mid-2009, growing at only a 1.9 percent year-over-year pace in April. Average hourly earnings, however, are not always the best indicator when attempting to spot early warnings of an inflationary spiral in the economy. The Employment Cost Index is a broader measure of labor costs that includes wages and salaries as well as fringe benefit costs, which take into account the cost firms incur to provide medical benefits to employees. Year-over-year, the cost of providing fringe benefits at firms is up 3.0 percent, largely driven by accelerating medical care costs and an aging American population. Many states are also imposing higher surcharges on firms to pay for the extension of unemployment insurance benefits. While these accelerating benefit costs may be atypical to the traditional wage-price spiral that economists are used to dealing with, there is nothing in economic literature that suggests a benefit-price spiral cannot occur. Indeed, many of today's most contentious compensation battles center around benefits.

Figure 3

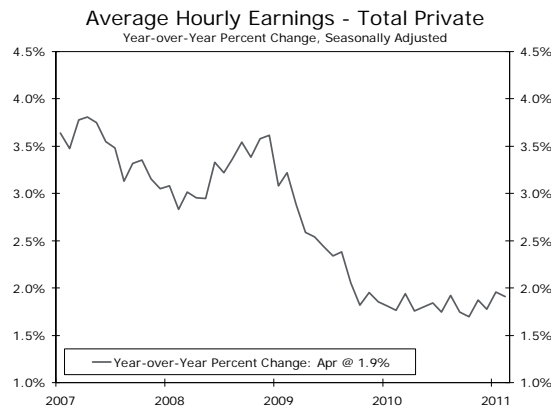
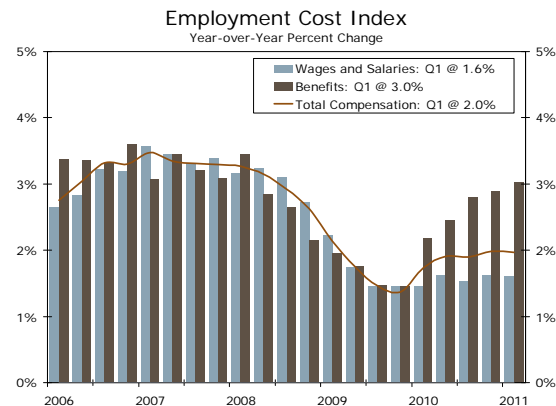


Figure 4



***The accelerating costs of providing fringe benefits to employees is a large impediment that is holding back hiring in the U.S. labor market.***

Source: U.S. Department of Labor and Wells Fargo Securities, LLC

The accelerating costs of providing fringe benefits to employees is a large impediment that is holding back hiring in the U.S. labor market. This, of course, is not a new phenomenon: Since the early 1980s, growth in health care spending per capita in the United States has been outpacing growth in the Consumer Price Index. The burden of higher health care costs feeding into higher medical care coverage costs for firms, however, took a while to show up in firms' hiring decisions. Even during the last economic expansion, from 2002 to 2007, when health care spending per capita in the United States was growing at a 5.9 percent compound annual growth rate, firms largely shrugged off higher medical care coverage costs and continued hiring new workers. Firms were able to do this because revenues and earnings were growing at a fast enough pace to absorb higher medical care coverage costs. Now, however, in the wake of the Great Recession, revenue growth has been harder to come by and businesses have been managing their bottom lines more

closely. The result has been less overall hiring as well as more use of contract, temporary and part-time positions, which, generally speaking, carry lower benefit costs for firms.

Figure 5

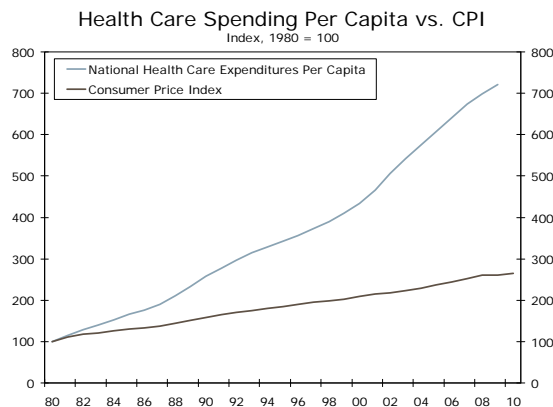


Figure 6



Source: CMS Data & Statistics, U.S. Department of Labor and Wells Fargo Securities, LLC

***One cannot deny the economy suffered a massive cyclical downturn following the bursting of the housing bubble and financial crisis.***

### How Much Has the NAIRU Risen?

Regardless of whether one is on the cyclical or structural side of the labor market debate, one cannot deny the economy suffered a massive cyclical downturn following the bursting of the housing bubble and financial crisis. From peak to trough, nearly \$7.5 trillion dollars in home equity was wiped away from the downturn, and home prices continue to slide in most large metro areas across the country. But while the housing market in the United States remains weak, the economy as a whole has bounced back a bit, with real GDP now above its pre-recession peak.

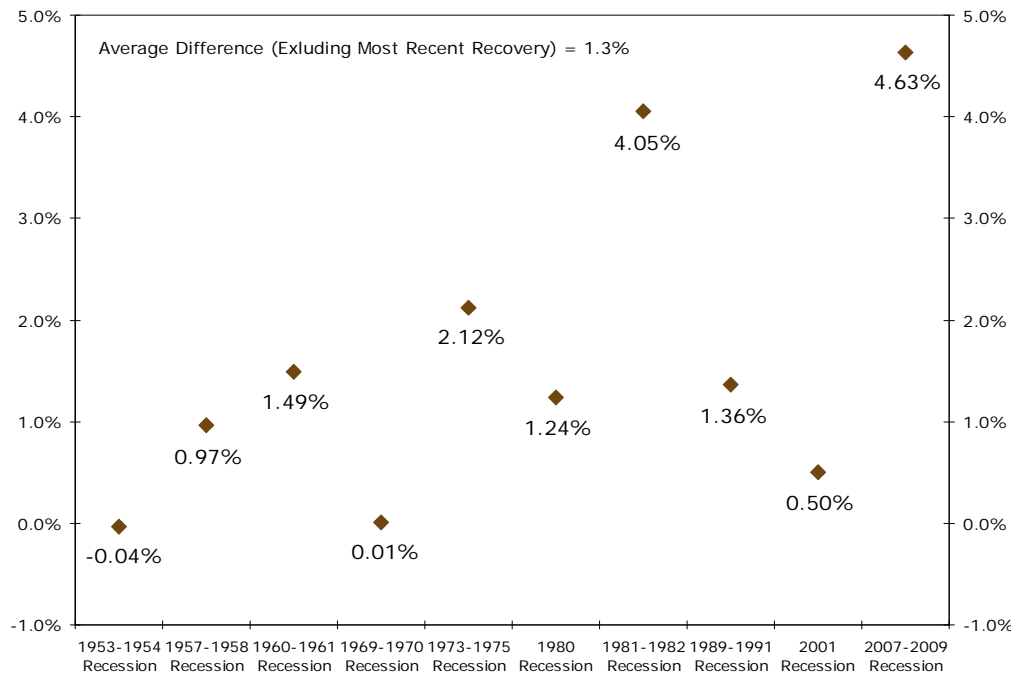
That real GDP has regained its pre-recession peak certainly does not imply that the unemployment rate should have fallen back down to the NAIRU; after all, the unemployment rate is a lagging economic indicator and trend productivity growth would have boosted output per worker well above its year-end 2007 level by now. Based on historical data, however, the unemployment rate should at least be making discernible progress toward returning to the NAIRU. When looking at past economic recoveries in the United States dating back to the 1950s, we find that the average difference between the unemployment rate and the NAIRU whenever real GDP regained its previous pre-recession peak is 1.3 percentage points.<sup>5</sup> At the end of last year, U.S. real GDP surpassed its 2007 pre-recession peak of \$13.36 trillion, but the gap between the unemployment rate and the NAIRU was over 4.6 percentage points. This is the largest gap ever recorded for this measurement, even surpassing the recovery following the 1981-1982 recession when the labor market experienced a sizable structural shift associated with the sharp decline in manufacturing employment, particularly in the steel and automotive sectors.<sup>6</sup>

<sup>5</sup> Using the CBO's estimate of the NAIRU and excluding the most recent economic recovery.

<sup>6</sup> U.S. Congress, Office of Technology Assessment. (1986). *Technology and Structural Unemployment: Reemploying Displaced Adults*. Library of Congress.

Figure 7

### Difference Between the Unemployment Rate and the NAIRU When Real GDP Returned to Previous Peak



Source: U.S. Department of Labor, Congressional Budget Office and Wells Fargo Securities, LLC

Taking our analysis one step further, we attempt to separate the cyclical and structural components of today's elevated unemployment rate by comparing peak-to-trough declines in real GDP from past economic recessions to corresponding differences between the unemployment rate and the NAIRU whenever real GDP regained its pre-recession peak after each recession. We find that when real GDP regained its pre-recession peak in the fourth quarter of last year, roughly 2.5 percentage points of the unemployment rate at that time were attributed to the cyclical nature of the Great Recession and 7.1 percentage points were caused by structural factors in the labor market.<sup>7</sup> Our sense is that structural factors have not improved very much since the fourth quarter of last year, and that the NAIRU is still likely elevated at around 7.1 percent. Recent evidence from the Federal Reserve Bank of Chicago suggests that the extension of unemployment insurance benefits throughout the Great Recession and recovery likely account for a 0.8 percentage point rise in the NAIRU, which can be interpreted as a transitory increase.<sup>8</sup> Therefore, we believe the new normal, non-transitory unemployment rate in the labor market is probably around 6.3 percent.<sup>9</sup>

We believe our estimates are extremely conservative, however, and the structural unemployment rate may actually be higher. The labor force participation rate has fallen precipitously over the past five years and is now back at levels last seen in the mid-1980s. The employment-population ratio has fallen even more significantly, tumbling 4.6 points to 58.4, returning to its lowest level since 1983. If just one-quarter of the 4.65 million people who dropped out of the workforce over

***Based on our calculations, the NAIRU has increased 2.1 percentage points to 7.1 percent.***

<sup>7</sup> For a detailed explanation of the analysis behind this result, please see the Appendix.

<sup>8</sup> Mazumder, Bhashkar (2011). *How Did Unemployment Extensions Affect the Unemployment Rate in 2008 - 10?* Federal Reserve Bank of Chicago.

<sup>9</sup> This is the result of taking our current estimate of the NAIRU at 7.1 percent minus the 0.8 percentage points of structural unemployment associated with the extension of unemployment insurance benefits.

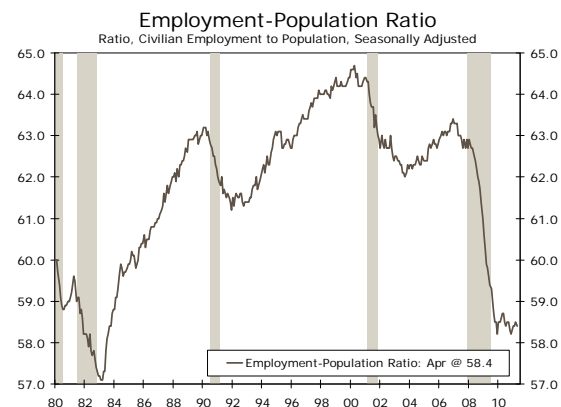


the past five years joined the ranks of the unemployed, the jobless rate would be 0.6 percentage points higher. This would put the structural unemployment rate at around 7.7 percent today and still nearly 7.0 percent after extended unemployment insurance benefits expire.

Figure 8



Figure 9



Source: U.S. Department of Labor and Wells Fargo Securities, LLC

### Skills Mismatch and Labor Mobility: The Story Most Deny to Be True

The labor market has improved in recent months, with the unemployment rate falling 0.8 percentage points since November. As mentioned, however, a noteworthy portion of the recent drop is due to declining labor force participation and not actual job growth. Nevertheless, our forecast calls for job growth to pick up through the rest of the year, with the economy adding a total of 2.1 million jobs in 2011. As good this sounds, our forecast continues to depict an unemployment rate well above the CBO's estimate of the NAIRU for the foreseeable future. The apparent mismatch between the characteristics of jobs that are available and the skills of displaced workers who lost jobs during the Great Recession is an important factor explaining our elevated unemployment rate projections.

Figure 10

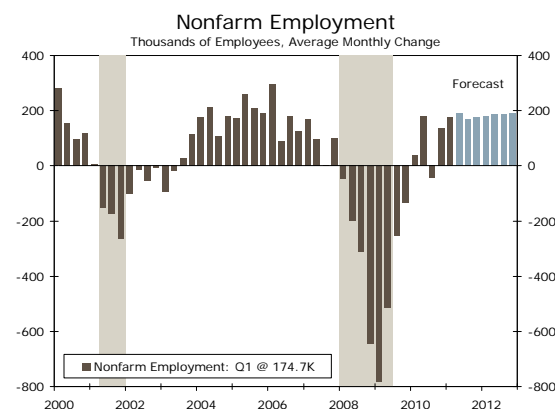
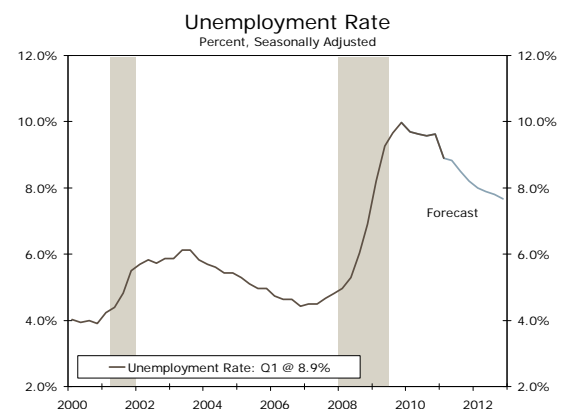


Figure 11



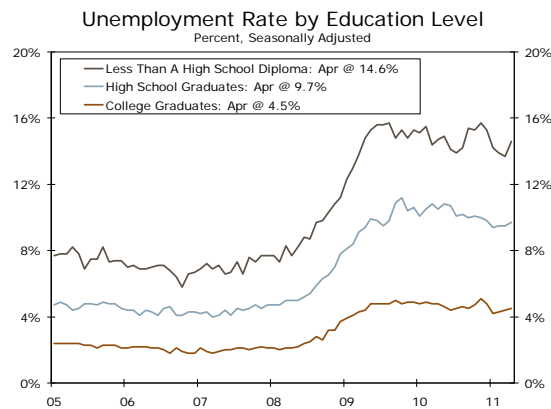
Source: U.S. Department of Labor and Wells Fargo Securities, LLC

The structure of the U.S. economy has changed dramatically over the past few decades, leading to an increase in the demand for more highly educated workers. Even long before the Great Recession, firms have been demanding more workers with greater technical proficiency, training and education. This is because of the causal relationship that exists between educational attainment and worker productivity.<sup>10</sup> One of the consequences of a recession is that inefficiencies are purged from the economy and productivity tends to increase. This was particularly true

<sup>10</sup> Jones, Patricia. (1999). *Are Educated Really Workers More Productive?* Vassar College.

during the Great Recession, when the severity of the financial crisis encouraged firms to make deeper and more dramatic cuts than they may have made in a more typical downturn. There is also research that suggests flexible employment regulations in the United States allowed firms to lay off lower-skilled workers first and at a more rapid pace during the Great Recession when compared to other developed economies around the world.<sup>11</sup> The high number of layoffs occurring among lower-skilled workers accounts for the relatively strong growth in U.S. labor productivity since the recession ended.

**Figure 12**

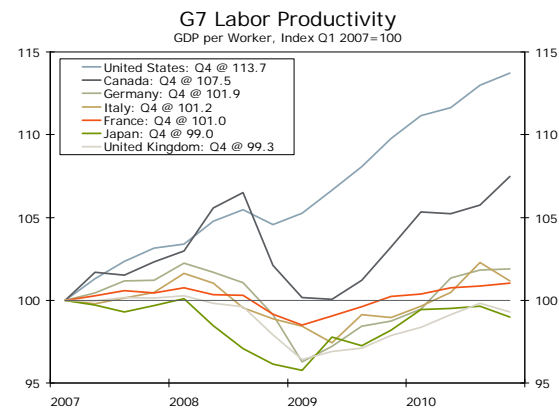


Source: U.S. Department of Labor, IHS Global Insight and Wells Fargo Securities, LLC

If it is the case that the workers with low skills were the first to lose their jobs when the recession hit, that would mean a large concentration of the 5.8 million workers who have been unemployed for more than 27 weeks—the definition of long-term unemployment—are workers with low skills and low levels of education. As workers' skills tend to deteriorate during long bouts of unemployment, the recent rise in long-term unemployment has created its own structural impediment by further widening the gulf between the skills demanded by employers and skill sets of jobseekers. This is one of the reasons why we think a substantial worker-employer skill mismatch is currently taking place in the labor market, especially between those who have been out of work the longest and employers requiring workers with advanced training and education to fulfill their hiring needs.

Another significant impediment relates to labor mobility and, specifically, the large portion of homeowners with a mortgage who are in a negative equity position. Historically, the U.S. labor market has been characterized as one of the most highly mobile labor markets in the world. That high mobility allowed workers to move freely around the country and take advantage of new job opportunities quickly as they arose in other demographic regions. The hyper-mobility of American workers, and American companies for that matter, also served as a strong motivating force for firms and states to remain competitive. Now, however, with many homeowners stuck in homes they cannot sell and many would-be homebuyers unable to obtain financing to purchase new homes, migration in America has slowed considerably. This is especially true in regions such as Florida, Nevada and Arizona that were hit the hardest by the housing bust. Housing markets are so weak in these states that many potential jobseekers are essentially stranded, because they are unable to sell their home and relocate to other parts of the country where job opportunities might be more abundant. Furthermore, a recent report published by the International Monetary Fund indicates that decreased labor mobility in areas hit the hardest by the housing bust may have had compounding effects on worker-employer skill mismatches in these regions.<sup>12</sup>

**Figure 13**



***The severity of the financial crisis encouraged firms to make deeper and more dramatic cuts than they may have made in a more typical downturn.***

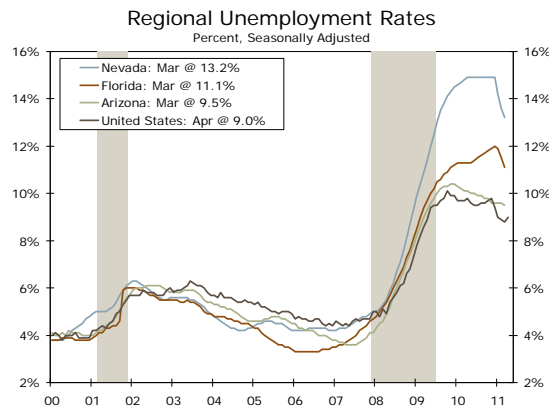
***The recent rise in long-term unemployment has created its own structural impediment by further widening the gulf between the skills demanded by employers and skill sets of jobseekers.***

<sup>11</sup> Andolfatto, David and Williams, Marcela M. (2011). *Many Moving Parts: A Look Inside the U.S. Labor Market*. Federal Reserve Bank of St. Louis.

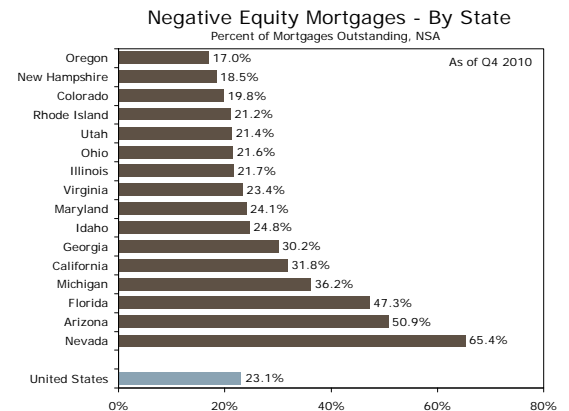
<sup>12</sup> Estevão, Marcello and Tsounta, Evridiki. (2011). *Has the Great Recession Raised U.S. Structural Unemployment?* International Monetary Fund.

***Without improving education levels for those that have been unemployed the longest, a sizable worker-employer skill mismatch will likely persist even after all of the excesses from last decade's momentous housing boom and bust are cleared out.***

**Figure 14**



**Figure 15**



Source: U.S. Department of Labor, CoreLogic and Wells Fargo Securities, LLC

The good news is that household formation is finally picking up. In addition, more workers, especially younger workers entering the labor market for the first time, are choosing to rent instead of buy homes. In addition, the huge overhang of existing housing units brought on by the housing bust is slowly clearing and home prices should finally bottom by the end of the year, which will stabilize negative equity positions in markets hit the hardest by the housing bust. Without improving education levels for those that have been unemployed the longest, though, a sizable worker-employer skill mismatch will likely persist even after all of the excesses from last decade's momentous housing boom and bust are cleared out.

### What Does This All Mean for Monetary Policy?

Most economists agree that while an accommodative monetary policy is the best medicine for curing cyclical unemployment, it does not do a whole lot to fix structural unemployment. While the economy has certainly benefited from a near-zero federal funds rate for more than two years and two rounds of large-scale asset purchases by the Federal Reserve, these policies have not helped improve the skill sets of workers in the labor force. Moreover, if policymakers underestimate how much structural unemployment exists in the labor market and monetary policy remains too easy for too long, it could have unintended damaging effects on the economy. The Federal Reserve's latest economic projections released on April 27 show the unemployment rate falling to between 6.8 percent and 7.2 percent by the end of 2013 and a longer-run unemployment rate somewhere between 5.2 percent to 5.6 percent.<sup>13</sup> While it was not mentioned specifically in these projections, the implication is that the Fed believes most of the recent rise in the NAIRU is transitory and the NAIRU will trend back down to somewhere between 5.2 percent to 5.6 percent in the long run, when all of the slack from the Great Recession is cleared out.

If structural issues in the labor market persist much longer than the Fed anticipates, and excessive monetary policy actions aimed at reducing the unemployment rate continue, the unintended outcome will be higher-than-expected inflation over the next few years. This is, in essence, the dual mandate dilemma that the Federal Reserve currently faces: Will the Fed start to tighten monetary policy in the face of high unemployment or will it keep monetary policy loose until the unemployment rate falls to a more comfortable level at the risk of generating higher-than-expected inflation in the economy?

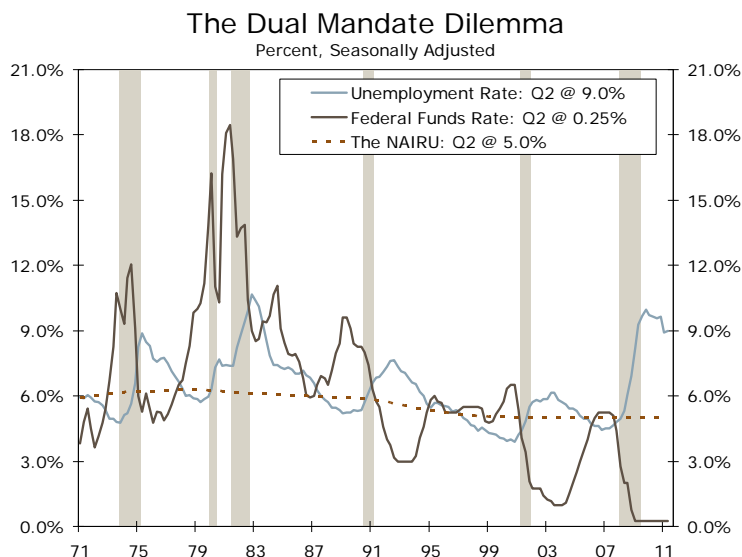
The Fed's dilemma is further complicated by today's unusually low federal funds rate. The Fed has a long way to go to bring the federal funds rate back up to a historically neutral level, at around 3.0 percent, and it does not have the luxury of waiting until the unemployment falls to a

<sup>13</sup> The Federal Reserve Board and the Federal Open Market Committee. (2011). *Economic Projections of Federal Reserve Board Members and Federal Reserve Bank Presidents, April 2011*. Board of Governors of the Federal Reserve System.



more historically comfortable, lower level because of the long and variable lag between changes in monetary policy and its effects on economic activity and inflation.

**Figure 16**



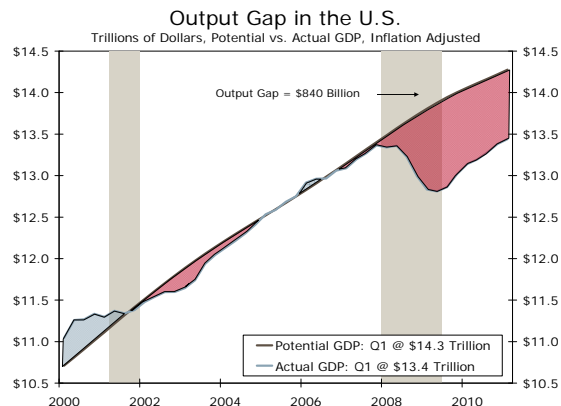
***Will the Fed start to tighten monetary policy in the face of high unemployment or will it keep monetary policy loose at the risk of generating higher-than-expected inflation in the economy?***

We believe the Fed will eventually be forced to tighten monetary policy despite a very high unemployment rate. Our forecast calls for the Fed to start raising interest rates early next year, with an unemployment rate still elevated at around 8.0 percent. Rising inflation expectations and improving economic fundamentals will likely force the Fed to accept the unfortunate fate that the new “normal” level of unemployment in the labor market is going to be higher in the post-Great Recession era. We also expect to see more research published by the Federal Reserve suggesting the NAIRU, or some other similar concept, has risen to around 7.0 percent.

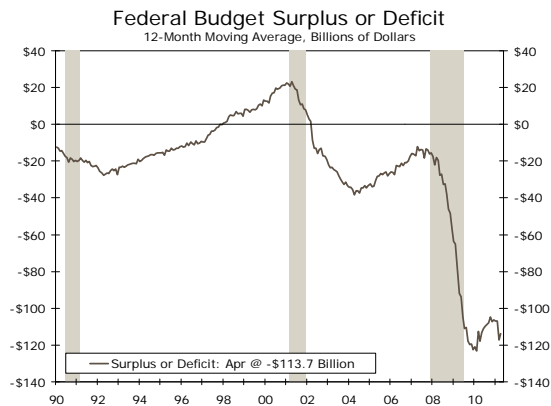
### **What Does This All Mean for Fiscal Policy?**

The persistence of high structural unemployment holds even greater consequences for fiscal policy. The federal budget is largely based on the notion that the economy will return to full employment, which forms the basis for long-term revenue projections. This is the reason the Congressional Budget Office and the Office of Management and Budget produce estimates of potential GDP. If structural unemployment has increased along the lines that we believe, then potential GDP and potential federal revenue growth are lower than currently projected. This means reducing the federal budget deficit will be even more difficult.

**Figure 17**



**Figure 18**



***If structural unemployment has increased along the lines that we believe, reducing the federal budget deficit will be even more difficult.***

Source: Congressional Budget Office, U.S. Department of Commerce and Wells Fargo Securities, LLC

***The most promising solutions to reducing structural unemployment involve reducing regulations that make it difficult to start and grow a business.***

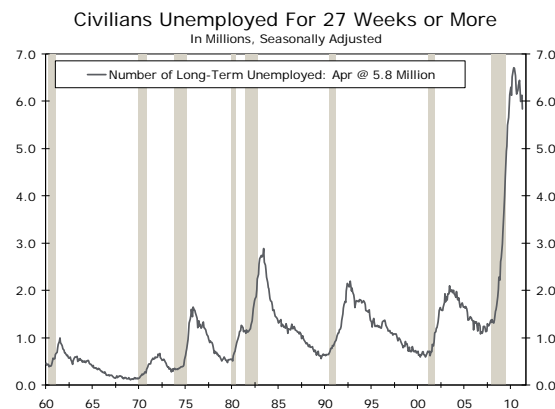
Large federal budget deficits also mean that it will be difficult for the federal government to craft effective policies to reduce structural unemployment. The truth is there is no silver bullet. Improving funding for community colleges and vocational education programs is a good place to start, but real reform will require improvements further back in the education system. Improving both the percentage of students graduating high school and the quality of those students is essential for preparing workers for today's rapidly evolving economy.

With budgets tight at all levels of government, the most promising solutions to reducing structural unemployment involve reducing regulations that make it difficult to start and grow a business. Policymakers might also take another look at the minimum wage and scale back programs that index the minimum wage to changes in the Consumer Price Index. Scaling back unemployment insurance benefits and tightening up on eligibility requirements for unemployment insurance and other social benefits may also help nudge unemployment lower. The trick is to do this in a way that does not harm those that truly are in need of help. Immigration reform, which slows the flow of unskilled workers into the country and encourages and simplifies the process for skilled workers to immigrate to the United States, would also help alleviate skill mismatches.

### Summary and Conclusions

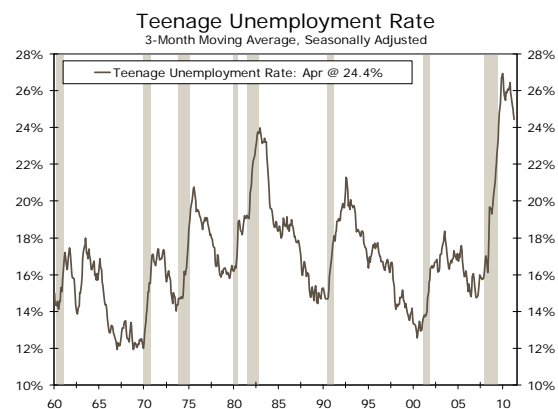
We believe a large proportion of today's high unemployment is structural in nature, resulting from a huge skill mismatch between the jobs being created and the existing skill sets of jobseekers. Just a casual glance at long-term unemployment or the unemployment rate for teenagers would suggest something momentous has changed. The widening gulf between the skills employers are demanding and the skills workers possess is being driven by the relentless pressures from globalization, which are discouraging labor-intensive activities and encouraging growth in more capital-intensive industries. Public policy, the housing bust and the persistence of high unemployment itself have all added to a higher structural unemployment rate in the U.S. labor market.

Figure 19



***Just a casual glance at long-term unemployment or the unemployment rate for teenagers would suggest something momentous has changed.***

Figure 20



Source: U.S. Department of Labor and Wells Fargo Securities, LLC

Reducing structural unemployment will be difficult. By definition, structural unemployment is long-lasting. We conservatively estimate the structural unemployment rate is currently at 7.1 percent, or 2.1 percentage points above the Congressional Budget Office's estimate. Around 0.8 percentage points of the increase is due to the extension of unemployment insurance benefits. Scaling back unemployment insurance benefits should push the structural unemployment rate down to between 6.0 percent and 6.5 percent. Reductions beyond that point will require much more significant actions, such as improving primary and secondary education, increasing funding for higher education and reducing the regulatory burden for starting and growing a business in the United States. Policymakers should also re-examine the increase in the minimum wage and consider allowing the real minimum wage to decline, particularly for teenagers, which have seen

their jobless rate skyrocket since the new law took effect. Finally, our estimates regarding structural unemployment are conservative. Taking into account significant drops in the labor force and the employment-population ratio would likely push the structural unemployment rate up to 7.7 percent and still leave it around 7.0 percent after adjusting for the expiration of extended unemployment insurance benefits.

### Appendix: NAIRU Analysis Following the Great Recession

With the assumption that the CBO's estimate of the NAIRU dating back to the 1950s represents the total amount of structural unemployment in the labor market for each previous recession and recovery—but excluding the Great Recession and recovery—our analysis goes as follows:

Let  $Y$  = The average historical gap, in percentage point terms, between real-GDP troughs and corresponding previous peaks.

$$\text{Then, } Y = \sum_{i=1}^n (100 - v_i)/n$$

Where  $v_i$  is the trough in real GDP during recession  $i$  (expressed as a percent of the previous peak in real GDP) and  $n$  is the number of historical recessions considered.

Let  $D$  = The average historical difference between the unemployment rate and the NAIRU whenever real GDP regained its previous peak following a recession.

$$\text{Then, } D = \sum_{i=1}^n (u_i - r_i)/n$$

Where  $u_i$  is the unemployment rate when real GDP regained its previous peak after recession  $i$  and  $r_i$  is the NAIRU when real GDP regained its previous peak after recession  $i$ . Here,  $n$  is again the number of historical recessions considered.

Let  $R = (100 - v_r)$ , where  $v_r$  is the trough in real GDP during the Great Recession (expressed again as a percent of the previous peak in real GDP).  $R$  represents the gap between the trough in real GDP and its previous peak during the Great Recession.

Then, let  $X = (R/Y)$ , where  $X$  is the cyclical severity of the Great Recession. In other words, the Great Recession was roughly  $X$  times as deep, in terms of the negative impact to real GDP, when compared to previous downturns.

Then, let  $C = (X)(D)$ , where  $C$  is the cyclical component of the unemployment rate following the Great Recession. Put differently, based on historical peak-to-trough declines in real GDP from past economic recessions and corresponding differences between the unemployment rate and the NAIRU whenever real GDP regained its previous peak, the unemployment rate should have been  $C$  percentage points above the NAIRU when real GDP regained its previous peak following the Great Recession if structural factors were not abnormally intensified.

Then, let  $S = (u_r - C)$ , where  $u_r$  is the unemployment rate when real GDP regained its previous peak following the Great Recession. It can then be inferred that  $S$  is the structural component of the unemployment rate following the Great Recession, which is precisely what we wanted to find.

Explicitly,

$$Y = 2.11$$

$$D = 1.30$$

$$R = 4.14$$

$$u_r = 9.63$$

$$\rightarrow X = (4.14)/(2.11) = 1.96$$

$$\rightarrow C = (1.96)(1.30) = 2.55$$

$$\rightarrow S = (9.63) - (2.55) = 7.08$$

*Note: For the calculation of  $Y$  and  $D$ , we exclude the Great Recession.*

## Wells Fargo Securities, LLC Economics Group

Diane Schumaker-Krieg	Head of Research & Economics	(704) 715-8437 (212) 214-5070	diane.schumaker@wellsfargo.com
Paul Jeanne	Associate Director of Research & Economics	(443) 263-6534	paul.jeanne@wellsfargo.com
John E. Silvia, Ph.D.	Chief Economist	(704) 374-7034	john.silvia@wellsfargo.com
Mark Vitner	Senior Economist	(704) 383-5635	mark.vitner@wellsfargo.com
Jay Bryson, Ph.D.	Global Economist	(704) 383-3518	jay.bryson@wellsfargo.com
Scott Anderson, Ph.D.	Senior Economist	(612) 667-9281	scott.a.anderson@wellsfargo.com
Eugenio Aleman, Ph.D.	Senior Economist	(704) 715-0314	eugenio.j.aleman@wellsfargo.com
Sam Bullard	Senior Economist	(704) 383-7372	sam.bullard@wellsfargo.com
Anika Khan	Economist	(704) 715-0575	anika.khan@wellsfargo.com
Azhar Iqbal	Econometrician	(704) 383-6805	azhar.iqbal@wellsfargo.com
Ed Kashmarek	Economist	(612) 667-0479	ed.kashmarek@wellsfargo.com
Tim Quinlan	Economist	(704) 374-4407	tim.quinlan@wellsfargo.com
Michael A. Brown	Economist	(704) 715-0569	michael.a.brown@wellsfargo.com
Tyler B. Kruse	Economic Analyst	(704) 715-1030	tyler.kruse@wellsfargo.com
Joe Seydl	Economic Analyst	(704) 715-1488	joseph.seydl@wellsfargo.com
Sarah Watt	Economic Analyst	(704) 374-7142	sarah.watt@wellsfargo.com

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